

What is claimed:

1. A method of forming droplets comprising the steps of:  
  
forming a sheath flow from three inlet streams wherein a first stream comprising a first solution is sandwiched between second and third streams comprising a second solution; and  
  
generating a droplet from the first stream.
2. The method of claim 1, wherein the first and second solution comprise immiscible fluid solutions.
3. The method of claim 1, wherein the first solution comprises an aqueous solution and the second solution comprises a solvent solution.
4. The method of claim 1, wherein the first solution comprises an aqueous solution and the second solution comprises an oil solution.
5. The method of claim 1, further comprising a step of dissolving a reagent in the first solution.
6. The method of claim 5, wherein the reagent comprises a drug.
7. The method of claim 1, further comprising a step of dissolving a first type of amphiphilic molecules in the second solution.
8. The method of claim 7, wherein the step of generating a droplet includes encapsulating the droplet with the amphiphilic molecules to form a monolayer vesicle.
9. The method of claim 8, further comprising the step of passing the monolayer vesicle through the first and second solution interface to form a bilayer vesicle

10. The method of claim 9, wherein the first and second solution interface comprises a second type of amphiphilic molecule.

11. The method of claim 10, wherein the second type of amphiphilic molecule is different from the first type of amphiphilic molecule.

12. The method of claim 9, wherein the first and second solution interface is formed by a third solution flowing through two downstream input channels.

13. The method of claim 1, further comprising dissolving a first type of polymer molecules in the second solution.

14. The method of claim 1, further comprising increasing a shear force generated by the second and third streams acting upon the first stream to overcome interfacial forces in the first stream.

15. The method of claim 14, wherein increasing the shear forces comprises increasing the flow rates of the second and third streams.

16. The method of claim 1, further comprising controlling flow rates of the three inlet streams.

17. The method of claim 13, wherein the flow rates are controlled by one or more pumps.

18. The method of claim 13, further comprising manipulating the flow rate of the first solution to control the rate of droplet formation, wherein the first solution comprises an aqueous solution.

19. The method of claim 13, further comprising increasing the flow rate of the second solution to decrease the size of the droplets formed, wherein the second solution comprises an oil solution.

20. The method of claim 13, further comprising decreasing the flow rate of the second solution to increase the size of the droplets formed, wherein the second solution comprises an oil solution.

21. A microfluidic device for droplet formation comprising:

- a first input microchannel comprising a first solution;
- second and third input microchannels comprising a second solution;
- a microchannel junction in communication with the first, second and third input microchannels;
- a plurality of pumps in communication with the three input microchannels to direct flow through the microchannels to the microchannel junction; and
- an output channel in communication with the microchannel junction.

22. The microfluidic device of claim 21, further comprising means for controlling shear forces between co-flows of the aqueous solution and oil solutions.

23. The microfluidic device of claim 22, wherein the means comprises controlling the flow rates of each of the three inlet microchannels by adjusting the three pumps.

24. The microfluidic device of claim 22, wherein the means comprises varying the dimensions of the microchannel junction.

25. The microfluidic device of claim 22, wherein the means comprises varying a viscosity of the first solution.

26. The microfluidic device of claim 22, wherein the means comprises varying a viscosity of the second solution.

27. The microfluidic device of claim 21, wherein a flow direction of the first input microchannel and a flow direction of the second input microchannel are oriented at an angle relative to each other of less than or equal to 60 degrees.

28. The microfluidic device of claim 21, wherein a flow direction of the first input microchannel and a flow direction of the third input microchannel are oriented at an angle relative to each other of less than or equal to 60 degrees.

29. The microfluidic device of claim 21, wherein a width of the microchannel junction is greater than the widths of the three input microchannels.

30. The microfluidic device of claim 21, wherein the output channel has a bowtie shape.

31. A method of manufacturing droplets comprising the steps of:

forming a sheath flow from three inlet streams wherein a first stream comprising a first solution is sandwiched between second and third streams comprising a second solution;

generating a droplet from the first stream; and

processing the droplet.

32. The method of claim 31, wherein processing comprises sorting the droplet.

33. The method of claim 32, wherein the droplet is sorted by size.

34. The method of claim 31, wherein processing comprises splitting the droplet.

35. The method of claim 34, wherein the droplet is split into two droplets of substantially equal size.

36. The method of claim 34, wherein the droplet is split into two droplets of unequal size.

37. The method of claim 31, wherein processing comprises fusing two or more droplets to form a larger droplet.

38. A microfluidic device for manufacturing droplets comprising:

a first input microchannel comprising a first solution;

second and third input microchannels comprising a second solution;

a microchannel junction in communication with the first, second and third input microchannels;

a plurality of pumps in communication with the three input microchannels to direct flow through the microchannels to the microchannel junction;

an output channel in communication with the microchannel junction; and

a droplet processor.

39. The microfluidic device of claim 38, wherein the droplet processor comprises a droplet splitter including:

a splitter input channel;

two or more daughter channels in communication with the splitter input channel;

a corner wall junction disposed between the daughter channels; and

a second plurality of pumps in communication with the daughter channels, wherein the pumps generate a pressure gradient between the daughter channels to split a droplet at the corner wall junction of the daughter microchannels.

40. The microfluidic device of claim 38, wherein the droplet processor comprises a droplet sorter including:

a sorter input channel;

a daughter channel in communication with the sorter input channel;

a second plurality of pumps in communication with the sorter input channel and the daughter channel, wherein the pumps generate a pressure gradient between the daughter channel and the sorter input channel to sort droplets.

41. The microfluidic device of claim 38, wherein the droplet processor comprises a droplet fuser including:

a first fusion input channel;

a second fusion input channel in communication with the first fusion input channel and having a necked region of reduced width;

a fusion channel junction in communication with the first and second fusion input channels;

a fusion output channel in communication with the fusion output junction.